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Surface Quality Assured Steel Bar Program

OG™

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Project Summary

Goal: Develop and demonstrate an SQA prototype that enables efficient process control and surface defect handling for surface quality of hot rolled steel bars.

Barriers: Lack of (1) a reliable surface defect detection system, (2) a means for accurately registering and tracking surface defects, and (3) the comprehensive knowledge of the complex rolling process.

Benefits: An estimated 2.5% reduction in the productivity of the target industries and 6 trillion Btu/year in energy saving by 2020.

FY05 Activities: Accurate speed measurement, rolling process pattern analysis, process control strategy development, secondary market analysis.

Participants: OG Technologies, University of Michigan, University of Wisconsin, Charter Steel, Inland Steel, Timken, TXI, Nucor, REP, and Metaldyne.

Barrier-Pathway-Metrics

Barriers

- Lack of a reliable surface defect detection system
- Lack of a means for accurately registering and tracking surface defects
- Complexity of the rolling process

Pathways

- Improved in-line surface defect detection capability with high detection accuracy
- Integrated (defects + mill) database systems
- Advanced data pattern extraction models
- New logistics for steel bar delivery

Critical Metrics

- Surface defect detection false positive rate at 2%
- Smallest inspected bar diameter at 5 mm
- Defect position registering accuracy at 0.02%
- Surface defect caused rejection at 2.5%

Background Info

- ***Needs from the industry***
  - Surface defect is significant, ~%50 of rejects
  - Surface defects tend to be sporadic
  - Uncertain defects increase cost of processing
- ***Technology sources***
  - OGT: *sensing, integration, commercialization*
  - University of Michigan: *identification/APC*
  - University of Wisconsin: *data mining*
  - Industry: *experience/in-sights*

Year 2004 Objectives

- *False positive rate reduced to 2% or lower*
- *Vibration suppression demonstrated*
- *Built prototype for speed measurement*
- *Collected mill data, analyzed with 6 out of 8 proposed approaches*
- *Complete market analysis for one of the 6 identified secondary targets*
- *Signed subcontracts by April 30, 2004*

Current Status

- *Defect Detection Algorithm*
  - Two more rolling installations, Inland & Timken (rod & bar)
  - Generating about 20GB images per month
  - 5% false positive rate based on recent in-line results
  - Verification of detected defects
- *Vibration Suppression*
  - Developed computer model for wire rod
  - Verification of model with real mill observation
  - Design of non-contact vibration suppression mechanisms
- *Speed Measurement*
  - In the process of preliminary design and test planning
  - Tested one technology experimentally on site

Current Status (cont.)

- *Data Analysis*
  - Started on June 1, 2004
  - Established mill & HotEye™ data collection channels with Inland and Charter by June 14.
- *Marketing*
  - Formed a team with Michigan Economic Development Corporation and Michigan Small Business Technology Development Center
  - Information collection on the identified potential target industries
  - Met with major rolling line equipment providers
- *Management*
  - Entered into subcontracts with Univ. of Michigan and Univ. of Wisconsin
  - UM & UW started on June 1, 2004

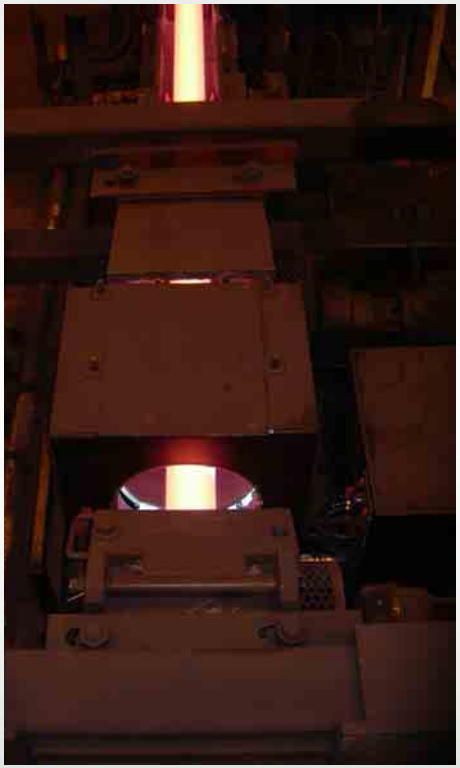
HotEye™ RSB @ Inland

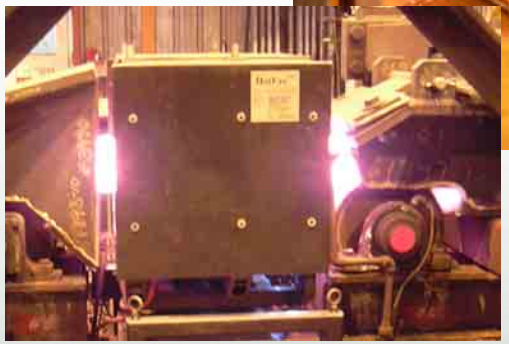
- Installed in November 2003.
- Commissioned in March 2004.
- For bars from 0.25” to 1.5” Dia.

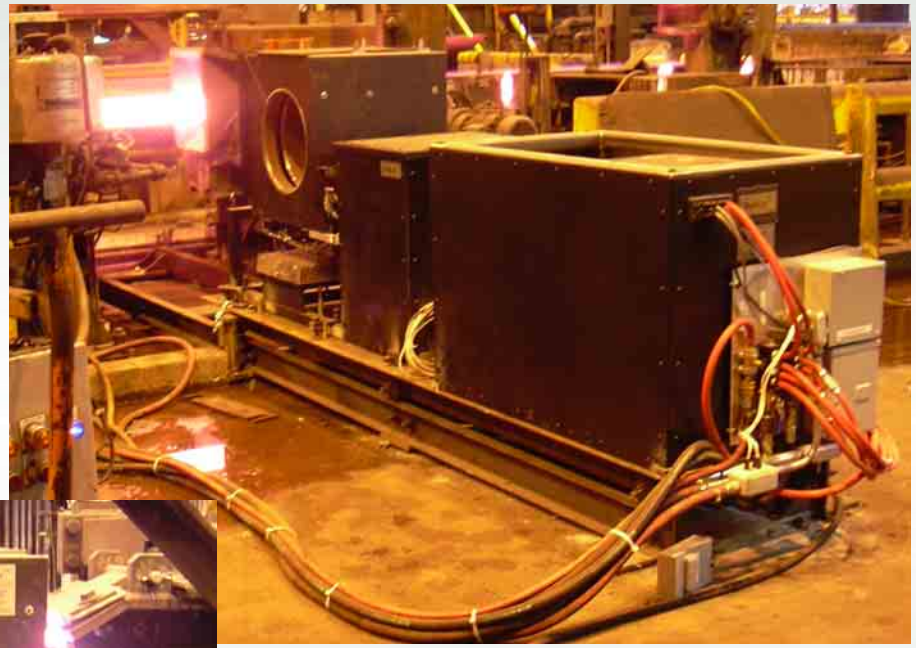
System supported by ITD/NICE³

HotEye™ RSB @ Timken

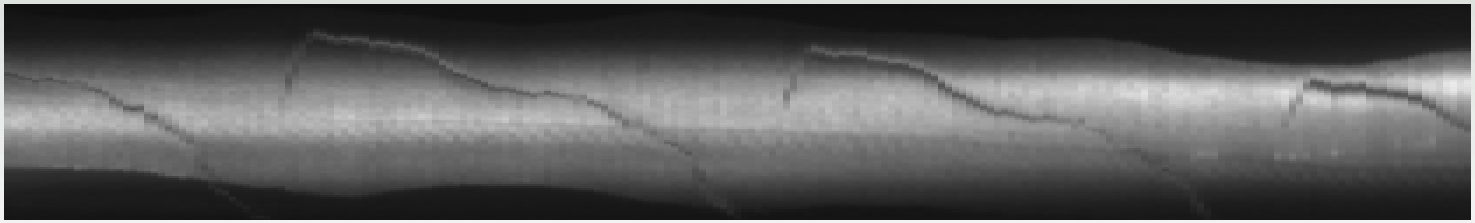
- Installation in February 2004.
- For bars from 2” to 6” Dia.
- Expected commissioning in July 2004.



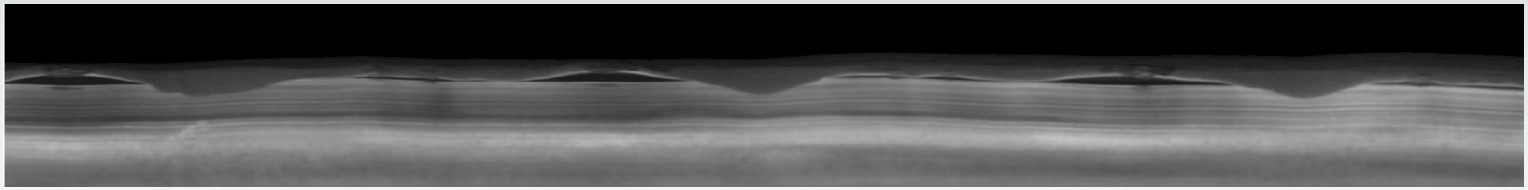




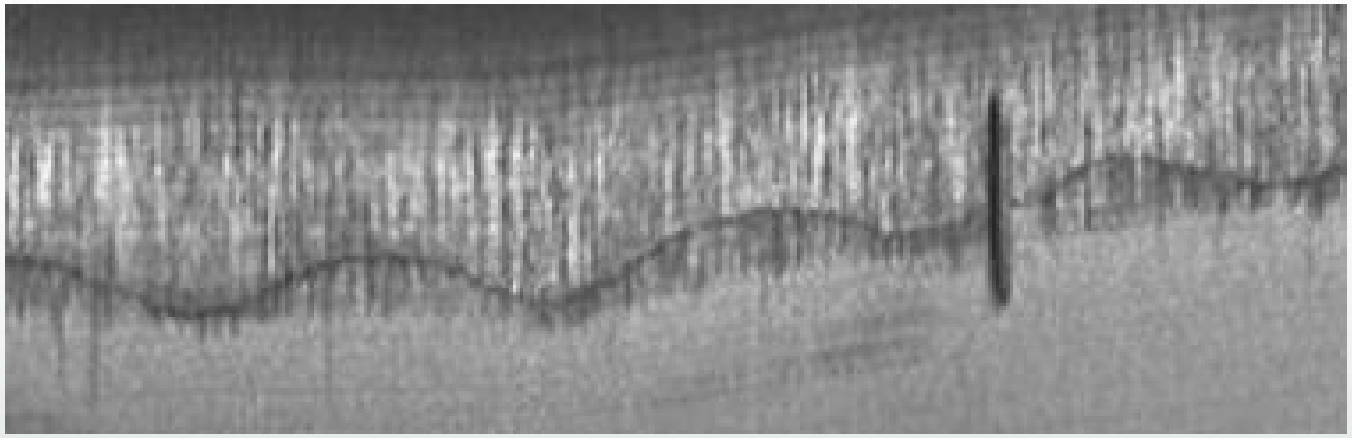
Roll Crack Detection



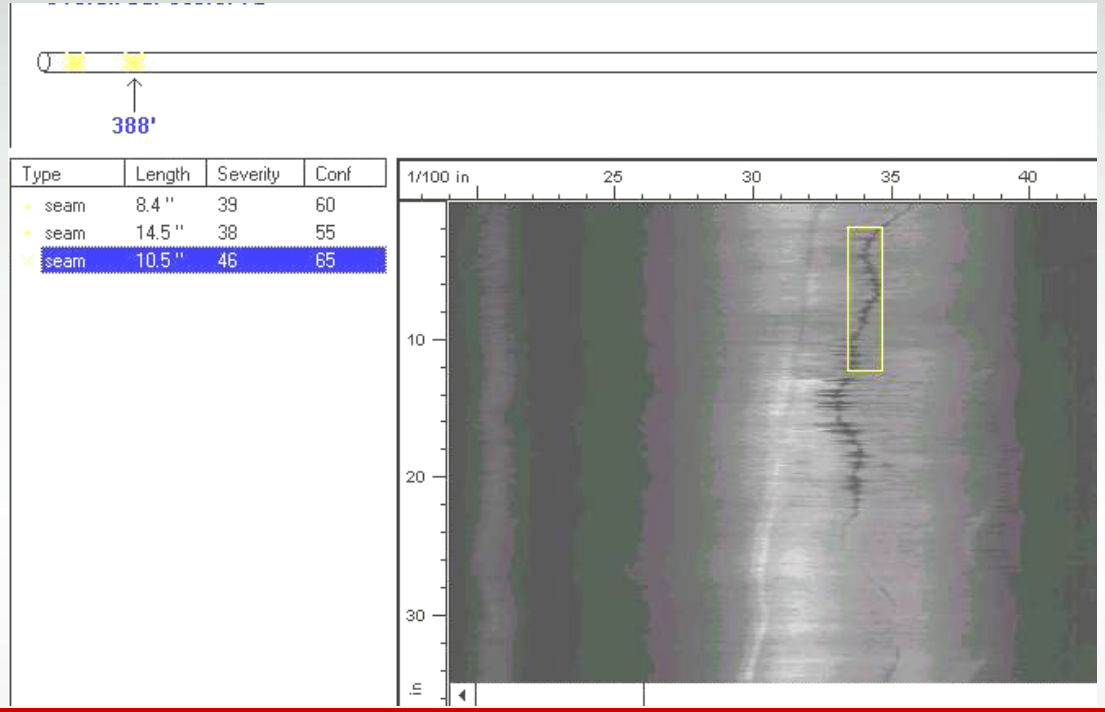
Overfill



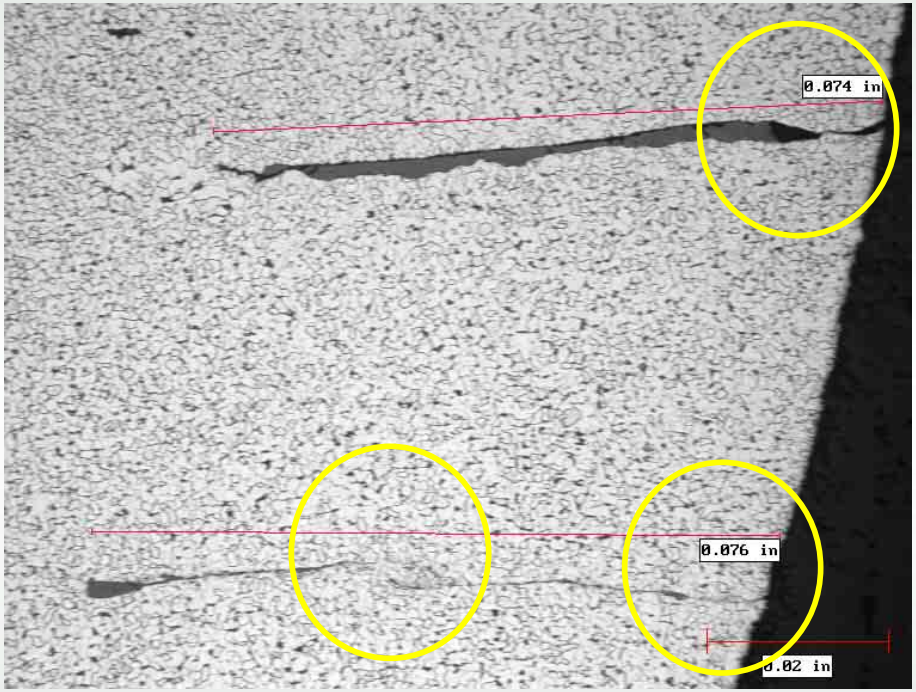
Transverse Defects



HotEye™ Detection



Seam Verification



Year 2005 Objectives

- *Demonstration of 0.02% accuracy in speed measurement*
- *Demonstration of off-line process diagnosis for rolling process faults that result in surface defects*

Year 2005 Tasks

- *Development of an accurate speed measurement device*
- *Surface defect pattern analysis of the rolling processes*
- *Development of the process control strategy for surface quality*
- *Market study of two more secondary targets*

Marketing

- *Current market status*
  - Steel industry is in its best period for years
  - No competing imaging technology in the long product sector
- *Marketing objective*
  - Solution provider to long product rolling mills for surface quality
- *Marketing activities*
  - Four steel companies visited Inland site since March 2004
  - Engaged two rolling equipment providers
  - Three outstanding business proposals
- *Current market position*
  - The only proven in-line seam/overfill detection system
  - Close cooperative relation with most US SBQ mills
  - Seeking worldwide patent protection

Summary

- *Program working closely with the target industry*
- *On track to deliver the FY 2004 targets*
- *FY 2005 tasks are as planned in the original proposal*
- *Establishing market position in surface detection systems*
- *Actively exploring additional applications of the technology*